14 NOV 1986

PATENT SPECIFICATION (11) 1 605 252

1 605 252

(21) Application Nos. 52704/76 (22) Filed 17 Dec 1976

(23) Complete Specification Filed 19 Dec 1977

(44) Complete Specification Published 4 Jun 1986

(51) INT. CL.[4] F02C 7/20 // 7/06 7/272

(52) Index at Acceptance F1G 15 18 3

(19)

(72) Inventors: Jack Britt

John Greer

(54) IMPROVEMENTS IN OR RELATING TO GAS TURBINE ENGINES

(71) We, ROLLS-ROYCE LIMITED, a British Company of 65 Buckingham Gate, London SW1E 6AT, formerly Rolls Royce (1971) Limited of Norfolk House, St. James Square, London SW1Y 4JR do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:-

This invention relates to a gas turbine engine and more particularly to expendible gas turbine engines of a type suitable for propelling a missile.

It is well known to propel missiles by means of either of the ram jet, the pulse jet, or solid or liquid propellant rocket type engine. All these types of engines suffer disadvantages. In the case of both the pulse jet and the ram jet it is necessary to propel the missile by other means such as, for example, an auxiliary rocket engine, or by attachment of the missile to an aircraft such that the missile can attain the necessary operating speed to pressurise the ram jet or pulse jet before it will operate. This is obviously unsatisfactory in that additional auxiliary engines add to both the weight and cost of the missile.

The solid or liquid propellant rocket engine does not suffer the aforementioned disadvantage, however such engines are not air breathing and this results in excessive weight of the completed missile in order to carry the necessary large quantities of fuel required even for short range operations. Because of this basic inefficiency this type of engine cannot really be considered practical for long range missions in the atmosphere.

An object of the present invention is to provide a propulsion unit for a missile which substantially eliminates the abovementioned problems.

According to the present invention an engine for a missile comprises a gas turbine engine which includes a single engine main shaft which carries adjacent its upstream end a compressor rotor and adjacent its downstream end a turbine rotor, the shaft being supported in a bearing at its upstream end from an annular member which is secured to the radially innermost portion of the compressor outlet guide vanes and being supported adjacent its downstream end in a bearing from a further two annular members one of which is secured to the radially innermost portion of the compressor outlet guide vanes and the other of which is secured to the radially innermost portion of the turbine inlet guide vanes, the engine also including a casing formed from a relatively weak material which is secured coaxially within and in spaced relationship with a further casing which is of a substantially higher strength than the engine casing.

During operation of the engine a supply of high pressure air is maintained between the two casings so that the higher strength outer casing provides a degree of support to the relatively thin section engine casing.

In one embodiment of the invention the engine is supported at an upstream location from the higher strength outer casing by three mounting bolts which are secured to the compressor outlet guide vanes and both the downstream end of the engine casing and the higher strength outer casing are provided with a plurality of snubbers which may contact with each other only when an out of balance occurs within the engine, under normal operating conditions the downstream portion of the engine is supported entirely by the pressurised air maintained between the two casings.

Preferably the higher strength casing comprises the casing of the missile.

Preferably the engine main shaft is designed such that at least a portion of it may be filled with a chemical charge which may be ignited such that the energy released therefrom is adapted to drive an auxiliary turbine which facilitates starting of the engine.

For better understanding of the invention an embodiment thereof will be more particulary described by way of example only and with reference to the accompanying drawings, in which:-

Figure 1 shows a cross-sectional side elevation of a portion of a gas turbine engine made in accordance with the present invention.

Figure 2 shows a further cross-sectional vi w of a porti n of the engine taken on line 2-2 at Figure 1.

Referring to Figur 1 of the drawings, a gas turbine engine, a portion of which is sh wn generally at 10 comprises in flow series, a compressor rotor 12 to which is attached three stages of compressor blades 13, 14 and 15. Two stages of stator vanes 16 and 17 are located between the respective compressor stages 13, 14 and 14,15 and the compressor section of the engine terminates in a stage of compressor outlet guide vanes 18. Furthermore, an annular air bleed manifold, not shown in the drawings, is arranged within the compressor casing from which high pressure air may be taken to drive the fuel pump of the engine.

Arranged downstream of the compressor outlet guide vanes 18 is the combustion section of the engine which comprises an annular combustion chamber 19 and its associated burners etc. which are not shown in the drawings. A stage of turbine inlet guide vanes 20 is arranged downstream of the combustion chamber 19 and these serve to direct the products of combustion from the combustion chamber 19 onto the single stage turbine 21. The combustion products subsequently exhaust through the exhaust nozzle 22.

Both the compressor rotor 12 and the turbine 21 are each secured to a common engine main shaft 23 which is rotatably mounted within bearings 24 and 25. The bearing 24 is secured to a fixed annular member 26 which is secured to or forms a part of the compressor outlet guide vanes 18. The bearings 25 is secured to two annular members one of which takes the form of an elongate substantially cylindrical member 27 which is secured to the compressor outlet guide vanes 18. The second annular member 28 which secures the bearing 25 is attached to, or forms a part of the turbine inlet guide vanes 20.

All the components which together make up the basic engine structure are arranged within an engine casing which takes the form of a relatively thin section structure 29. This structure 29 is further surrounded by a second high strength casing 30 which in this instance forms a part of the missile casing.

During normal operation of the engine the relatively thin section engine casing 29 would not in itself be sufficiently strong to withstand the pressures generated by the engine. However high pressure air is forced between the casing 29 and the second casing 30 by ram effect during normal forward flight and in this way the second casing 30 serves to constrain the relatively thin section casing 29 and hence relieve the pressure load exerted upon it by the gas pressure within the engine.

The engine is secured within the outer casing 30 by means of three engine mounting bolts, one of which is shown at 31. Each bolt serves to secure the upstream porti n of the engine concentric with the outer casing 30. The mounting bolts are arranged to be secured to a portion of the compressor outlet guide vanes 18.

The only other engine support provided comprises a plurality of corresponding snubbing members 32 and 33 which are arranged upon the radially innermost surface of the outermost casing 30, and the radially outermost surface of the thin section engine casing 29 respectively. During normal operation of the engine a clearance is defined between the snubbing members 32 and 33 in that the engine casing 29 and the outer casing 30 are maintained concentric by the upstream mounting bolts 31. If however an out of balance occurs upon the engine the snubbing members 32 and 33 may come into contact with each other. Details of the snubbing members 32 and 33 are shown on an enlarged scale at Figure 2.

It is also considered that the engine may include its own starting device and in this instance at least a portion of the main shaft 23 is packed with a chemical mixture which may be ignited electrically or by other suitable means. The gases released by the chemical mixture are then expanded through an auxiliary turbine provided within, or adjacent to, the downstream end of the shaft (the auxiliary turbine etc. is not shown in the drawings). The auxiliary turbine then serves to drive the shaft 23 up to operating speed such that the engine's main compressor 12 and turbine 21 may commence to function and thus produce the engine's propulsive combustion products.

WHAT WE CLAIM IS:-

1. An engine for a missile comprising a gas turbine engine which includes a single engine main shaft which carries adjacent its upstream end a compressor rotor and adjacent its downstream end a turbine rotor, the shaft being supported in a bearing at its upstream end from an annular member which is secured to the radially innermost portion of the compressor outlet guide vanes and being supported adjacent its downstream end in a bearing from a further two annular members one of which is secured to the radially innermost portion of the compressor outlet guide vanes and the other of which is secured to the radially innermost portion of the turbine inlet guide vanes, and in which the engine casing is formed from a relatively weak material which is secured coaxially within and in spaced relationship with a further casing which is of a substantially higher strength than that of the inner casing.

2. An engine for a missile as claimed in Claim 1 in which during operation of the engine a supply of high pressure air is maintained between the two casings so that the higher strength outer casing provides a

degree of support to the relatively thin section engine casing.

3. An engine for a missile as claimed in Claim 1 in which the engine is supported at an upstream location from the higher strength outer casing by three mounting bolts which are secured to the compressor outlet guide vanes and both the downstream end of the engine casing and the higher strength outer casing are provided with a plurality of snubbers which may contact each other only when an out of balance condition exists within the engine. Under most operating conditions the downstream portion of the engine is supported entirely by the pressurised air maintained between the two casings.

4. An engine for a missile as claimed in any of the preceeding claims in which the higher strength casing comprises the casing of the missile.

5. An engine for a missile as claimed in Claim 1 in which the engine main shaft includes a portion that may be filled with a chemical charge which may be ignited such that the energy released th refrom is adapted to drive an auxiliary turbine which facilitates starting of the engine.

6. An engine for a missile as claimed in any preceeding claim substantially as hereinbefore described with reference to the accompanying drawings.

For the Applicants

G.T. KELVIE
CHARTERED PATENT AGENT

Printed for Her Majesty's Stationery Office by MML Walderslade, Kent. 1986. Published at the Patent Office, 25 Southampton Buildings, London WC2 1AY, from which copies may be obtained.

Fig. 1.

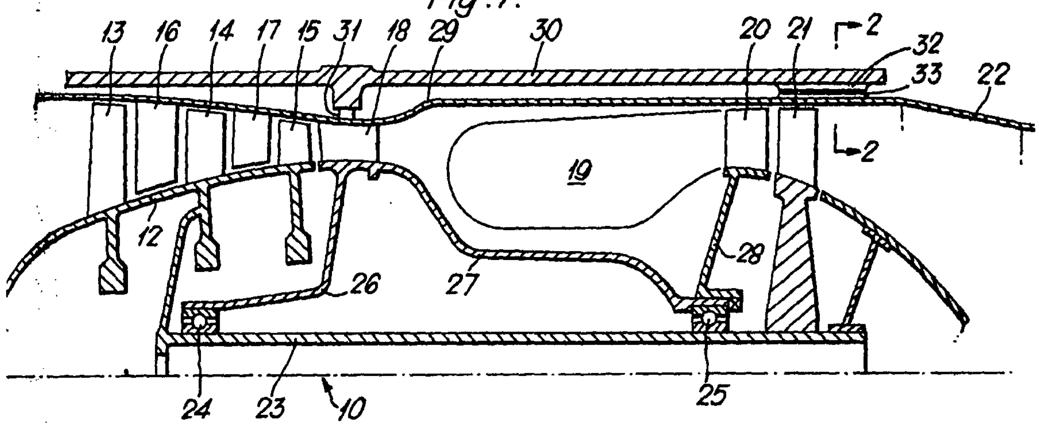
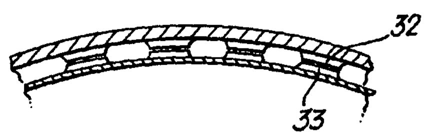

13
16
14
17
15
31
18
29
30
20
21
2
32
33
22
2
19
12
26
27
28
24
23
10
25

Fig. 2.


32
33